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Data for Spatial Planning – A Comparison of Three Cities

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1 ABSTRACT

Spatial planning relies on the availability of spatial data like land use maps, cadastral maps, traffic and pollution information, and data on infrastructure. There is a variety of techniques for capturing, storing, managing, and distributing these data. Different cities adopted different techniques and thus have different processes. This makes it difficult for cities in developing countries to decide, which approach to take and which solution to implement. The paper sketches the situation in three different cities, Vienna (Austria), Bratislava (Slovak Republic), and Teheran (Iran). Available data, their quality, and their usage in spatial planning are presented. The differences, problems, and opportunities of each of the solutions are then discussed.

2 INTRODUCTION

Spatial planning shall guarantee that natural resources and especially land are used efficiently and social interactions are provided with the necessary space. Spatial planning in a city provides a special challenge: Cities have a high population density and thus social conflicts can easily arise. Cities are important driving forces in environmental trends as a consequence of the increase in the share of the global population that reside in urban areas and the large intensity of activities of urban dwellers. As the world continues to urbanize, however, humans have lost contact with soil and the services it provides to sustain life (Braimoh and Vlek 2008). Spatial planning is one of the tools to prevent conflicts between different groups or different processes by assigning enough space to each group and for each process. This requires

- information about what is there,
- information about what is missing, and
- information about existing and emerging conflicts.

This information can be acquired by collecting data and discussion with the population. The idea that citizens are local experts (Goodchild 2008) can be used to gather the information but requires processes that allow citizens to contact the planning authority and provide the information. On the receiving end the planning authority must process the information and develop a picture of the city that shows existing and emerging conflicts and unused potential.

The structure of the paper is as follows. We start with a brief introduction in the data necessary for spatial planning and in the typical processes. Then the situation in the three cities is presented and compared. A brief discussion of the results completes the paper.

3 DATA AND PROCESSES FOR SPATIAL PLANNING

A basic type of information necessary for spatial planning is information on existing objects. The most obvious kinds of objects are roads and buildings. These are necessary for a number of different applications. The level of detail varies between the applications. For example, suitability assessment for solar panels is possible with block models of buildings with approximate roof structures (Kapfenberger-Pock 2010) whereas visualization demands detailed roof structures and even façade textures. Data sets containing these kind of information are usually derived from aerial photography (Ünsalan and Boyer 2005) and laser scanning (Morgan and Tempeli 2000). Then typically data on land coverage is available, too.

Traffic planning requires additional data like traffic density, street capacity, public transport routes, etc. This information will be used when addressing problems like traffic congestions or air pollution cause by traffic. Problems like noise pollution may also influence the planning problems.

A major issue for spatial planning is the available infrastructure. Streets and buildings have already been mentioned. However, supply lines for gas, water, and electricity, sewer capacities, street illumination, and service installations like hospitals or schools are important aspects in spatial planning. Data on these installations are necessary for efficient spatial planning. These data should also be available to the public because then the data can be used by additional services, e.g., in case of disasters.

Processes of spatial planning should include public (Lanza and Tilio 2010). Public participation has a long tradition in many countries since it is an effective measure to ensure that spatial planning solutions are accepted by the public. Traditional methods include public meetings and discussions, publications of plans including the possibility to raise objections, and public contests. Recently, online methods have been investigated, too (e.g., Steinmann, Krek et al. 2004). However, these methods have not yet been broadly used since they have still some problems. The largest challenge is that not everybody interested in the discussion has access to the Internet. Thus alternative methods are necessary and these are typically in analogue form. Thus online methods are mainly used as an additional possibility for discussion.

Land owners are an example for a group that should be involved in the planning process at some point. The implementation of planned changes may affect them and thus they should at least be informed about the change. In addition to data on the planned changes this requires information on land ownership and the spatial extent of the land owned by a specific person. Thus systems like a cadastre and a land register must be in place to provide this information. Even if there is no concept of private land ownership there will be people who use the land. In this case these people should be informed and the necessary information must be provided by some form of information system.

The results of the planning processes should be made publicly visible again. Typical methods are land use and land planning maps. These can be published in analogue and/or digital form. Traditionally, the maps were analogue and could be inspected at the planning offices and a number of other places. The changes in the producing process of these maps include the step from analogue to digital mapping. This leads to the availability of digital land use and land planning maps. These are easy to copy and distribute. The typical channel for distribution is the Internet. Accessing these kinds of maps is then easier compared to the analogue maps and this may stimulate more active involvement of the public in planning processes.

Rising income levels lead to changes in the urban economy’s consumption and production patterns that have the unintended benefit of greening the city. Most important, people in richer cities are more likely to consume higher-quality products and to work in the service sector. These behavioural changes help offset the pollution-causing effects of increasing scale (Kahn 2006).

Efforts to use such comparisons to rank cities in terms of greenness are complicated by the fact that many factors help determine how pollution affects a city’s health. Geographic factors, for example, can sharply increase or reduce a city’s vulnerability to dangerous emissions (Kahn 2006).

Urban population growth is a key driver of environmental degradation. As more people crowd into cities, the problems of urban air pollution, water pollution, and solid waste production all grow worse. New migrants do not simply increase the scale of economic activity; they also tax and sometimes overwhelm basic infrastructure services. As a result urban sustainability, as measured by both the ecological footprint and public health approaches, declines. This is an ironic outcome, given that most new urbanites are drawn to cities by the hope of a better quality of life.

The restructuring of social relations, which has been chartered from the international through to the local level, has not been uniform either across the three nation states or across the many regions which have been identified. The patterns suggest both continuities and breaks with the past. A continuity has been the increasing scale of activity which has shifted decision-making for many aspects of economic activity increasingly to the national or international sphere. Given this shift, debate has emerged as to the continued significance of the local area in this restructured capitalist system (Thorns 1992).

4 CITY SITUATIONS

There are two approaches how to see our study, whether this established set of examples actually provides a picture of development as such, or whether it represents a collection of inspiring special cases. Three different cities are compared in the paper. Two of the cities are situated in central Europe, one in Asia. Each of the authors selected a city in his home-country and thus cities from Austria (Vienna), Slovakia (Bratislava), and the Iran (Teheran) have been selected.

4.1 Vienna

The city of Vienna started in the 1970ies with electronic data management. One of the triggers to use spatial information technology was the increased need for spatial analysis. After a short period of analogue processing, digital storage and processing equipment was used. One of the first projects was a large scale, high quality base map of Vienna, the “Stadtkarte Wien”. The map was the result of a complete survey of all relevant objects in Vienna and is still the basis for many services provided by the city of Vienna. In the late 1980ies Vienna moved to GIS technology, which allows connecting geographical information with all kinds of user data. This geodata network is called ViennaGIS. Since 1995 an increasing amount of applications is also available in the Internet to stipulate public use of the data and services (ViennaGIS 2011).

Not all data are collected by the city of Vienna. Land register and cadastre are maintained by the Republic of Austria. These registers started the digitization of their data in the 1970ies and since the mid 1990ies all data are available in digital form. This allows online access of the most current land owner data.

The data collection of the city of Vienna can be accessed from an internal and external viewpoint. Each viewpoint corresponds to a defined set of rights in terms of data accessibility and editing. Hence, the external viewpoint utilizes a web based GIS capable of visualizing data approved for public use. In contrast, the internal viewpoint is intended for intra-administration use, which provides restricted data as well as editing rights.

The administration of the city of Vienna has a department which is, among other duties, responsible for the internet applications – the external viewpoint on Vienna's data. Services like the digital street map and the address finder are well known and widely used. A large number of results from spatial planning are also distributed using this channel including

- intended land use plan (Flächenwidmungs- und Bebauungsplan),
- prohibitions on building,
- protected zones,
- zones of world heritage,
- projects of city development,
- networks of public transport, streets, and bicycle routes,
- natural protection zones, and
- service installations like Libraries, kindergartens, and schools.

Figure 1 shows three different kinds of data that can be shown on top of the Vienna base map.

Land owners are automatically informed if there are changes in the intended land use in the vicinity of their property. This is necessary if land owners may have the right to object changes. It is a simple task if all necessary data are available in digital form as it is the case in Vienna. The digital process then replaces a labour intensive process of extracting first the land parcels, then their owners, and finally their addresses. The simplification of such processes is one of the benefits of a digital system like it is used in Vienna.

The Viennese system is quite expensive. The city of Vienna supports a large number of organizational units, which are directly or indirectly required for spatial planning. The department for maintaining the Internet applications is also responsible for the computer equipment in the whole organization and consists of approx. 500 persons. The surveying department creates data for the 2D maps of Vienna and the 3D city model. Two departments deal with questions of land use planning, one with strategic development, one with planning of social and medical services, and there are many more.

Fig. 1: ViennaGIS maps for the inner city of Vienna showing the Viennese base map (leftmost), land use plan (left), cadastral map (right), roof potential for solar collectors (rightmost).

All of the departments work with electronic data and produce their results in electronic form. This allows simple publication of the data on the homepage of the city of Vienna. It also enables sharing the data between the departments. The city model, for example, can be used by all other departments by simply accessing the shared model. It is not necessary to distribute updates in paper for or by using data storage media like CDs or DVDs. This enables quick update cycled and a high currency of the data.

4.2 Bratislava

The situation is slightly different in Bratislava. The Bratislava region is severely tied to the regions of Vienna, Brno, Gyor, and Budapest and has potential as a centre for European-wide flow of capital, services, research, and cultural and social cooperation. However, the land use plan of Bratislava must comply with the requirements for nature protection and propose options for new economic activities.

Currently the city of Bratislava creates its own spatial information portal, which has the ambition to provide citizens with comprehensive spatial information over public networks. The proposed advanced solution will enable timely provision of current information about the real state space city in universally accessible and understandable form. The data held by the municipal agenda in the form of regulations, records, drawings and maps are inserted through special features in the databases. They consist of information about the location of sources of pollution, waste management, the state of public green spaces, traffic organization and management, urban real estate, geodetic documentation of buildings, up-to-date street names, and valid regulations for new investment plans and their realization.

Data organization and structure in a digital environment is designed to avoid multiple information acquisition in agenda of individual municipal departments in the future. This shall increase the efficiency of municipal operations, in particular by restricting multiple data insertion and immediately publishing new data.

A basic component of spatial information portal is the computer basis of the digital technical map of the city (DTM). This map contains information about geometric arrangement of buildings above and below the surface, the relief, and the technical infrastructure.

New data are continuously inserted into the database according to geodetic survey of new buildings. Information outputs are generated in the form of cartographically processed map editions in the scale of 1:500 or as a digital record of map sheets on digital storage medium like CD-ROM. The municipality also provides spatial information and specific maps in the scales of 1:10 000, 1:2000 and digital aerial photos intended for projecting buildings, architectural studies, and general plans. Such information is available for citizens on a daily basis in a specialized municipality department. This department also offers advice on the use of the data and the limitations of the data sets.

Employees of the municipality office can use the portal to access the data created by them in the field of environment, construction, traffic and transport, municipal property. However, the portal also allows linking the data to data from other. This allows, for example, cross-validation with general developing plans, land-use zone plans, and spatial plan of city. Software applications allow analysis of data according to various criteria, monitor relations between different kinds of data, or derive new relations.

Data that the municipality has at its disposal include

- aerial photos,
- vector cadastral map (under the agreement with Slovak Geodesy, Cartography and Cadastre Authority), and
- digital technical map of city (held in .dgn format).

The digital technical map of the city is published under city regulation act no. 1/1995 and is property of capital city of Bratislava. It is a part of the city information system and represents a core component of its land use identification base. The municipality provides

- liability to notify changes of digital map content,
- evidence of technical equipment operators/administrators, and
- release of data from digital map according to user requests.

The digital technical map of Bratislava contains

- selected parts of spatial database of geodesy, cartography and cadastre information system in the form of vector cadastre map (at 1:1000 scale),
- selected parts of information system of real estate cadastre,
- information about planimetry, altimetry and description, and
- selected parts of technical documentation from different information systems of technical equipment operators/administrators.

Objects to measure and locate within digital technical map are:

- permanently stabilized geodetic points of planimetry and altimetry,
- all the buildings larger than 1m2 or areas requiring permission,
- traffic networks and equipment,
- public green,
- water areas,
- objects and infrastructure of technical equipment,
- borders of cadastre districts, parcels, protected areas, etc.,
- altimetry data,
- description (street names, institutions), and
- other information like land resources or borders of urbanized areas (Figure 2).

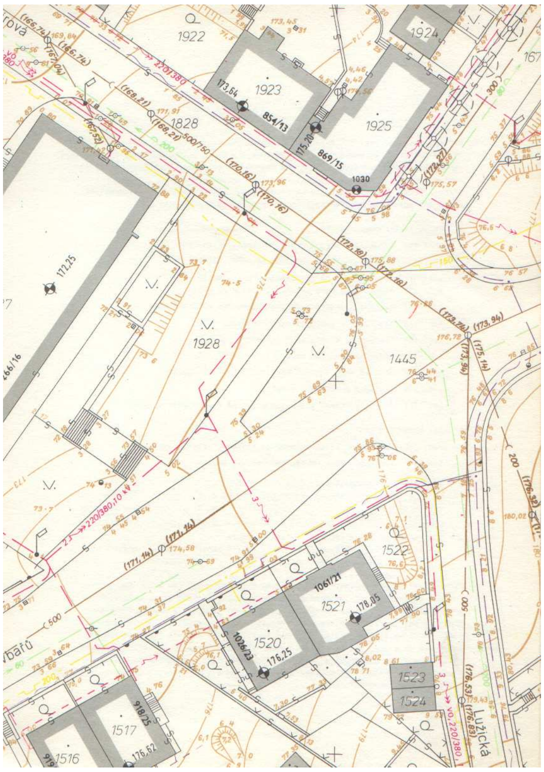

Fig. 2 Digital technical map of the city (part)

Updating of the DTM is done continuously by the municipality. The data are available due to the liability to notify changes for all operators, administrators of technical equipment, subjects performing building activities, and new geodetic measures.

The currently valid land use urban plan of Bratislava is available as a PDF output, and partially in the geoportal of Bratislava administrative region (Figure 3). This land use plan provides information on the parts of the city for which it is necessary to create and approve land use plans of city zones. It also serves as a basis for guiding the investment activities and for spatial decision making.

The environmental agenda has not been strictly incorporated into Bratislava municipality politics in last two decades because of pressure of investing groups. As a consequence there are buildings in some areas of the city that do not fit to their neighbourhood and the intended land use. There are, for example, parking lots where green areas should be, and streets serve mainly as transit traffic corridors that have not been intended for this task. It will take a longer time to correct these mistakes and bad decisions in urban planning and to increase urban environmental quality. There is great potential to make good decisions and implement clever urban projects in “brownfield” sites which comprise relatively large areas of former factories.

Bratislava relies significantly on automobile mobility. There is need for a strong recognition of the problems (environmental and others) and limitations of city development. However, this has not yet been addressed.

Of course, there is no guarantee that higher incomes will translate into greener consumption. As city became more prosperous, it also changes urban production patterns in a way that promotes greater investments in quality of life. Finally, income growth gives politicians both the incentives and the means to make urban sustainability a significant policy priority. Urban economic growth can also increase demand for greener policies. In addition, in many post-industrial cities, the tourism sector is a growing employer. This industry represents another powerful force lobbying to preserve quality of life in urban areas.

Because there is no suitable geoportal of the city itself, the citizens can partially use the geoportal of the Bratislava administrative region (http://212.5.204.197/). This situation does not suit current needs of the citizens and other subjects in the city (scale, etc.) and new solutions have to be developed and implemented.

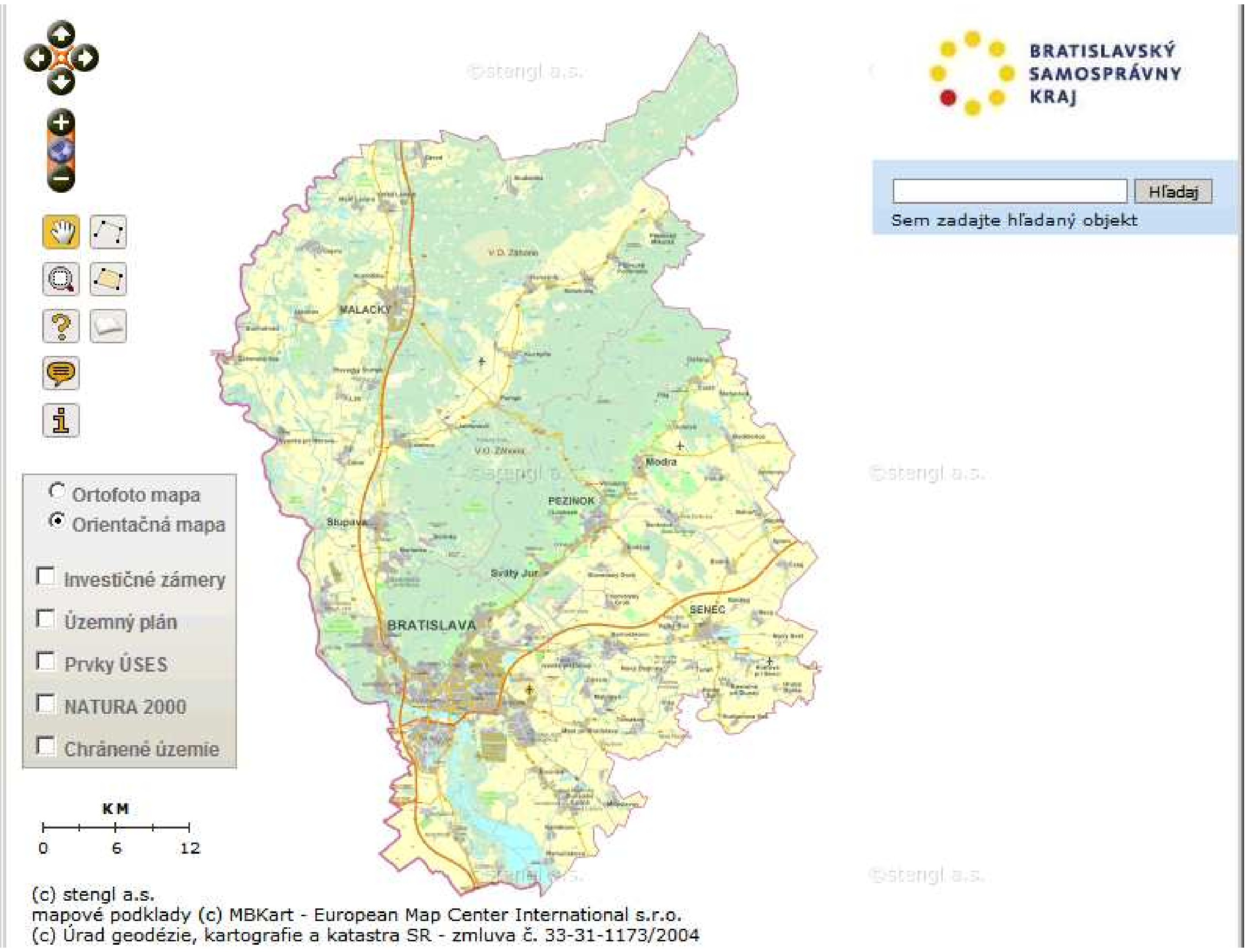

Fig. 3 Geoportal of Bratislava administrative region

Currently, public users cannot access data from digital technical map of Bratislava directly. Citizens can request data on a specific part of the city and receive a static map. The Bratislava municipality provides and maintains digital technical map as a base for decision processes, but it is not directly accessible for the public since it is only intended for internal purposes. That creates a barrier for spatial analysis and the general usage of the well prepared spatial information of the city. Public access to urban land use plans in form of pdf files with description and textual information is available and fulfills the obligation to make this kind of data public. However, spatial information as a static, hardly readable map is not sufficient and does not satisfy current public needs.

4.3 Teheran

Several organizations are responsible for collecting and maintaining spatial data for Tehran. The national cartographic centre (NCC) provides digital covering maps (scale: 1:12000) for all Iranian cities, including Tehran, which are updated each 5 to 10 years. It has information types such as parcels, land use and land cover, streets, etc. This data is sold publicly by this organization.

The national cadastre organization is responsible for providing cadastral data for all the country. Cadastral data has been available for Tehran in form of paper maps since 2002. Digitization of these data has been recently started and is still in progress. Cadastral data can be ordered by owners or organizations, but it not yet publicly available.

Besides the above mentioned national data providers, the Tehran Geographical Information Centre (TGIC) collects and maintains several types of spatial data for Tehran. They provide public online data for (Figure 4)

- street networks and traffic,
- public transport: bus, BRT and metro,
- underground faculties: water, power, and gas lines,

- protected and historical zones, and
- facilities such as schools, hospitals, fire stations, and stores.

On the other hand, TGIC is responsible to provide the public data for a project to reconstruct the depreciated regions of Tehran. Tehran is located on several active faults and this project aims to reduce the damages of probable future natural hazards (especially earthquakes) through renovating the old regions of the city as well as managing the suburbanising. A master plan (Figure 5) together with the following data enables to derive a spatial planning process:

- Faults: Activity status, information on last activity (e.g. last activity, magnitude, etc.)
- Buildings: Structure, material, construction date, number of floors, etc.
- Streets: Width, construction date, material, etc.
- Underground faculties: type, possible danger, etc.

This information is available for public in order to know the status of a certain building in this regard.

Fig. 4: A sample of spatial data provided by Tehran Geographical information centre (TGIC)

Fig. 5: A sample of Tehran master plan

5 COMPARISON

Each of the three presented cities has spatial data, which are also used for spatial planning. Each of the cities has also recognized the value of having digital data. However, there are large differences in the availability of these digital data. Vienna started the creation of a digital map base 30 years ago and nowadays has a solid digital database to work on. In Bratislava the digitization started later due to other important tasks after the democratisation of the country and the split from the Czech Republic. Thus the basic data are available but the processes to use and distribute them are not yet completely in place. Finally, the data for Teheran is not yet completely digitized. The importance of digital data for efficient processes was recognized after the experiences of other countries were perceived. However, this is also an advantage because the city of Teheran can incorporate the experiences of other cities and avoid mistakes. It allows for a more modern design of the system, too. The effect of such a situation should not be underestimated. A comparison of public access for cadastral data in Austria and countries like Slovenia or Belarus shows that the older Austrian system is much more complicated and user unfriendly than the modern competitors. This demonstrates the advantage a city may utilize to create a modern and efficient spatial planning environment.

The comparison also showed that the design of the processes is time-consuming. The city of Vienna has an environment where spatial planners as well as the public can access spatial data. There are differences in the quality of the accessible data but the reasons for this are comprehensible. The access to some data may be restricted due to privacy or security issues. The existence and capacity of underground telephone cables, for example, may be important for spatial development and the implementation of infrastructure projects. The information, which of the lines leads to the headquarter of a major company, however, may be protected by law. These differences are well developed and tested in Vienna. In Bratislava, the system is still in the creational phase. Processes are still subject to change and are sometimes bypassed. This leads to sometimes undesirable situations but it is a typical problem in a transition phase. The processes in Teheran are in a similar phase. However, since parts of the data are still available in analogue form only, the processes will require significant re-engineering. Thus, Teheran will experience similar difficulties as visible in Bratislava.

6 CONCLUSIONS

The comparison of the cities showed that the three cities are in different phases of the transition from analogue to digital spatial planning. Spatial planning processes are in place in all three cities. The main difference is the availability, use, and distribution of these data. Teheran is still in the phase of digitizing the core data (phase 1). In Bratislava this phase is finished and the administration is adjusting the processes and legal rules to efficiently use the digital data (phase 2). In Vienna the processes and legal regulations are settled working (phase 3).

The most interesting phase from a research perspective is probably phase 3. The basic processes and regulations are in place and new strategies can be tested and (if successful) implemented. This is the phase where online public participation is evaluated, interconnections are be used for automation and better (or more transparent) decisions, and interdependences can be investigated and balanced.

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